

signal to background

Tesla coils sing electrifying duets; printers crank out 3D prototypes; breadsick souls hold tastings in Tsukuba; geeks cruise the Caribbean; Congress gains a physicist; *Numb3rs* character joins the DZero experiment



Photo: Jeff Larson, Fermilab

Now *that's* serious metal music

Tesla coils always draw crowds, and the DucKon science fiction convention in Naperville, Illinois, was no exception. People gathered around the seven-foot-tall metal transformer tower and awaited its monotone crackle, purple sparks, and thrilling flashes of artificial lightning.

But this coil had other plans.

As it fired up, the pitch of its crackle began to rise and fall. A tune emerged. People in the crowd started to cheer and clap. They began to dance. Someone held up a lighter.

A listener shouted a request: "Free Bird" by Lynyrd Skynyrd.

Thanks to Steve Ward, electricity lovers had a soundtrack.

Tesla coils were invented about 100 years ago in a quest

to transfer electricity wirelessly. Today they're known mostly for their entertainment value, used in science projects, haunted houses, and conventions, as well as for movie props.

Ward studies electrical engineering at the University of Illinois at Urbana-Champaign. A YouTube video of his coil's June DucKon performance has received more than a million hits. And a friend of his, Jeff Larson, a senior technician at Fermi National Accelerator Laboratory in Illinois, has built another singing coil so they could perform duets.

Larson estimates that fewer than a few dozen Tesla coils make music. "Our setup got so much attention because it was so big," he says. "Most musical Tesla coils are only a

few feet high and shoot sparks that are a couple of feet long. We can produce 13 feet of spark with ours."

The music starts when a laptop computer signals the coil to emit a spark. The spark heats the air, making a popping noise; when sparks are emitted in rapid succession their sound merges into a musical note. The faster the sparks emerge, the higher-pitched the note.

Ward has written music for this bizarre new instrument. Together, the Tesla twins can be heard humming anything from the theme of the *Mario Bros.* video game to "Dance of the Sugar Plum Fairy" from the *Nutcracker* ballet.

Haley Bridger



Photo: SLAC

Taking prototypes to the next dimension

As popular as the snack vending machine it resembles, a new 3D printer has been busy dispensing plastic-wrapped treats for designers and engineers.

Since the Dimension Elite printer arrived at Stanford Linear Accelerator Center in early January, its tea-box-sized printing head has been on the move day and night, whirring and clicking like a home inkjet printer while it automatically builds up models by depositing many thin layers of melted plastic.

The lightweight models that emerge are more tangible than a set of design drawings and more totable than a 35-pound metal model, easily carried to meetings to show colleagues how a design for an accelerator component would work.

"It's a service for engineers and designers across the lab to study the form, fit, and function of their designs before cutting them in metal," says engineer Kurt Vaillancourt.

Known generically as rapid prototyping machines, 3D printers and their ilk have been used in industry since the late 1980s. The one in SLAC's Mechanical Design Department can build pieces up to 8 inches square by 12 inches high, in layers as thin as 0.007 inch.

Designer Gene Anzalone and his colleagues have eagerly taken advantage of the printer to build models of a collimator that could be used to upgrade the Large Hadron Collider, which is scheduled to start operating this year in Geneva, Switzerland. Collimators block

stray particles inside a pipe carrying particle beams. This one is designed to rotate when damaged, presenting a fresh face of metal so the collider can keep working without interruption.

It took about five days to make the 3D plastic model, which showed that the design worked well. Since the printer works unattended, it saves money on labor as well as materials.

"The model is accurate enough to gain an understanding of how well the parts fit together into a working assemblage," says engineer Steve Lundgren, "and it gives us tangible results at an early phase of the project."

Heather Rock Woods

A yen for dough like mom made

Many high-energy physics laboratories have athletic clubs, music clubs, or chess clubs, but a bread-tasting club? Only in Japan. And only at Koo Energy Ken, KEK, outside of Tsukuba.

Bread Tasters of Tsukuba, or BRETT, formed in late 2005 in response to some foreign scientists' distaste for Japanese bread.

"It tastes like five-day-old Wonder Bread," says Tokio Ohska, referring to the soft, white sandwich bread that took on an iconic status in the United States as far back as the 1930s.

To be fair, bread is not a staple of the Japanese diet. What Europeans and Americans would eat with bread, the Japanese eat with rice.

Still, food reminds people of the comforts of home, and some foreign scientists and their families were getting a little homesick, not to mention hungry. That presented a problem for Ohska, who as head of the KEK research services office is charged with making foreign scientists feel comfortable at the lab.

Nearby bakeries initially turned down requests to make Western-style bread, citing a lack of imported flour and yeast as well as a lack of demand from Asian customers. So scientists took things into their own hands—literally.

One French scientist started importing ingredients and making his own bread. Ohska tried a different tack. He gathered 15 KEK members, mostly physicists from Europe, America, and Brazil, and started BRETT.

Although members have not met recently, at their most active the bread tasters gathered roughly twice a year to sample 30 breads from area bakeries. They sniffed, pinched, and eyed the doughy specimens as if they were the finest glasses of wine. Each piece was rated on its texture, taste, crust, interior, and fragrance.

To keep their palates untainted by foreign flavors, eaters could consume only water, plain tea, olive oil, and unsalted butter with the breads. "Nothing else is provided to the judges, who have to eat through some 30 baguettes," Ohska says. "It is a kind of torture, but they endure it faithfully."

Five Japanese newspapers have run articles on the bread club and published the results of tastings. "This made the bakeries in this town sort of worried," Ohska says. "Now, one of the bakeries is bringing its bread especially in to KEK. It is sold in the restaurant and at the grocery store on site."

And so Ohska's food dreams came true: Taste it, and they will come.

Tona Kunz



Geek Cruise

For most people, a Caribbean cruise is an opportunity for sun-splashed daydreaming, guiltless beach reading, and lackadaisical dips in warm, shimmering waters—in other words, complete mental repose. But when Stanford Linear Accelerator Center's Bebo White and Tom Abel boarded the MS Veendam in January, they and their ship-mates had a slightly different agenda.

With the help of four other scientists and two editors from *Scientific American*, White and Abel filled the days on board the Veendam with stimulating lectures, turning it into the challenging intellectual environment known as a Geek Cruise. The 25 lectures covered a wide range of topics, from White's computational science and Abel's astrophysics to evolution, virtual reality, and archaeology.

"It's a really fun experience," says White, who lectured on his first Geek Cruise, called Website Waves, a year and a half ago. "One of the best things about these cruises is that between lectures you talk with everyone at dinner, on deck, and during day trips, so you really become a close-knit group."

The first Geek Cruise, Perl Whirl, embarked in 2000. Most—for instance, Linux

Lunacy, Mac Mania, and Chess Moves—have been quite focused. "With those cruises," says White, "you need to teach a skill. There's nothing like that on this one. We're trying to appeal to their curiosity, and make the subject interesting enough so if they want to know more they can pursue it further."

The January cruise, called Bright Horizons, was Abel's first—Geek or otherwise—and he was excited about bringing his lectures to this unique environment. "It's always great to have a chance to share the fun science you do with the public," he says.

The western Caribbean's cultural richness and tropical charm could not, of course, be ignored by even the geekiest of minds. Cruise participants enjoyed full-day excursions in Key West, Belize City, Santo Tomás de Castilla, and Cozumel, participating in activities as diverse as zip-lining through the rainforest canopy and climbing the ruins of the Mayan temples of Tikal.

"All the talks and programs are during the period at sea," says White, "so when you get to the ports, everyone can play tourist. That way, the lectures really only cut into your casino time."

Lizzie Buchen



Photo courtesy of CBS

Numb3rs to DZero

On the hit television show *Numb3rs*, where crimes are solved with math and science, cosmologist and theoretical physicist Larry Fleinhardt has lived in a monastery and flown into space searching for a sense of purpose. The next step takes him to Fermilab.

Fleinhardt, played by actor Peter MacNicol, told nine million viewers in January that he had accepted an offer to join the lab's DZero experiment, calling it "the work of a lifetime."

An earlier episode had him describing the job this way: "Can you imagine? Smashing protons at 99.99 percent of the speed of light, all to locate a single fragment which would move us one step closer to

Photo courtesy of Tom Abel, SLAC





unifying all physics, explaining how the Old One created the universe? Ah, what could be more spiritual?"

DZero is one of two experiments at the Tevatron accelerator that are racing to find the Higgs boson, a theoretical particle thought to endow other particles with mass. That search for one of the Holy Grails of particle physics attracted the attention of the show's writers.

Fleinhart plays both sidekick and mentor to *Numb3rs* mathematician Charlie Eppes. Ever since the series started he has struggled to construct a workable 11-dimensional super-gravity theory. That quest recently led him to focus on particle physics and the search for the Higgs, according to the show's co-creator, Nick Falacci.

Scientists working on DZero love the idea and have created an office for the make-believe physicist.

For the time being, the extent of Fleinhart's involvement with DZero is unclear, and the show's creators have not decided if he will actually visit Fermilab.

But Darien Wood, co-spokesperson for the DZero experiment, says even limited involvement would be a plus.

"The characters on the show speak with great excitement and reverence about the search for the Higgs boson at DZero, and I think it captures some of the passion that we real particle physicists have for our work," he says. "Maybe young people who watch the show will even think about pursuing physics as a career."

**Haley Bridger and
Tona Kunz**

One more physicist goes to Congress

Upon becoming the third physicist in the 110th US Congress, Bill Foster called his election "a pretty successful experiment"

The scientific community hopes it's a statistically significant experiment as well, signaling that the American public may want, and support, more scientists in public office.

Foster's win with 53 percent of the vote, in a March special election to fill the seat of retiring Illinois Rep. Dennis Hastert, makes him one of eight people among the 535 voting members of Congress who hold science PhDs. They include physicists Rush Holt of New Jersey and Vern Ehlers of Michigan, both in the House of Representatives.

While the economy, health care, and the war in Iraq were in the forefront of Foster's House campaign, he also touted his scientific credentials in commercials and mailers and on his Web site. He was endorsed by 28 Nobel laureates and many top researchers. Foster pledged to bring the same thorough analysis to politics that he brought to his business—a company that manufactures more than half the theater lighting in the

United States—and to his 22 years as a Fermilab researcher.

While at Fermilab, Foster co-designed the Recycler, an antiproton storage ring that has increased the rate of particle collisions at the lab's Tevatron accelerator. He was one of six employees to win a federal energy award for their use of permanent magnets in the construction of a beam line, which saved water and energy and reduced waste. Foster also worked on the Collider Detector at Fermilab, which discovered the top quark, and designed a computer chip to make faster and more accurate measurements of particle collisions.

Foster says an understanding of science and technology is key to solving the economic and technological challenges of the modern age, from climate change to the feasibility of electronic border fences. "My entire career has been spent solving problems," he said in a press release.

"Washington needs more solutions and less squabbling. As a scientist and businessman, I have the right formula to bring about real change."

Tona Kunz

Former Fermilab physicists Bill Foster (right), now a member of the US House of Representatives, and Gerry Jackson inspect components for a new particle storage ring in 1996.

